BRULTECH RESEARCH INC

GEM Quick Guide

Basic Installation Manual

For 120V/240V Single Phase Installation Only!

DOC Code: GEM-QGD
Ver 1.0

This manual is an installation brief. For more detailed information, download a more detailed version from our site:
www.brultech.com/software

Introduction

NOTE:

- **Do not use this manual for 3-phase or 120V/208V systems fed from two legs of a three phase service. Refer to the three phase guide available from the site listed below.**
- **This document provides brief installation instructions. A more detailed and up to date User's Manual is available from Brultech website: www.brultech.com/software**

Compliance

FCC Compliance

The GreenEye Monitor has been tested to Comply with FCC Standards for Home and Office Use.
This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1) this device may not cause harmful interference, and
(2) this device must accept any interference received, including interference that may cause undesired operation.

Wireless Versions:

Contains FCC ID: OUR-XBEE2 (USA) (Wireless Versions Only)
Contains Model XBee® ZNet 2.5 Radio, IC: 4214A-XBEE2 (Canada)
May Contain Roving Networks WiFly Module FCC ID: T9J-RN171
May Contain FCC ID: AZYHF-A111

UL and CSA Compliance

The GREENEYE MONITOR (GEM) operates as a "Class II" low voltage device. This requires that all connections to the GEM comply with the following:

1. Voltage from external signal must be "Low Voltage" (less than 50V) and galvanic isolated from "line" voltages
2. All connections to the GEM must be "Class II" double insulated
3. The current transformer (CT), potential transformer (PT) and power supply must be UL/c certified when used in USA or Canada
4. The GEM device must NOT be installed inside an electrical panel possessing line voltages.

Installation of the GreenEye Monitor must comply with all local codes and must be installed by qualified personnel.

In the Box

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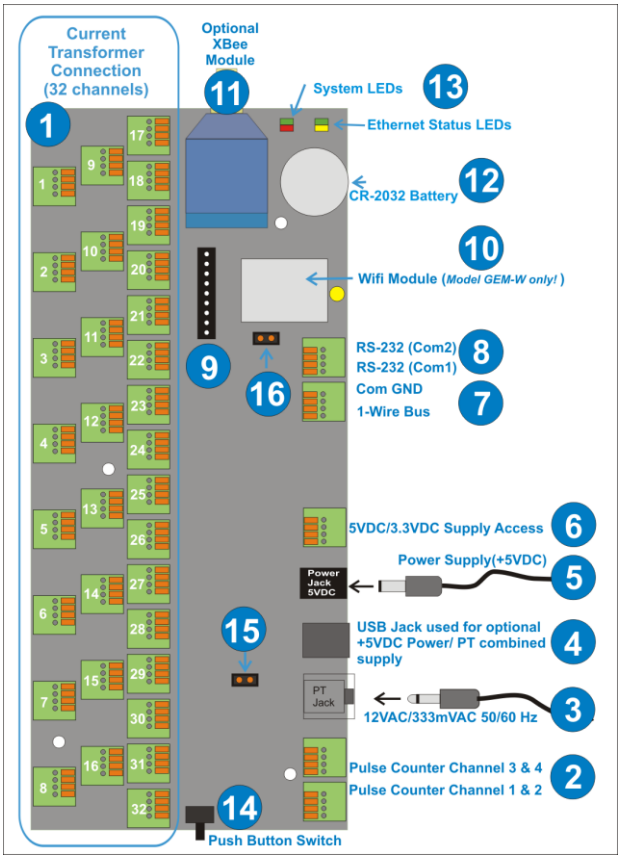

Figure 1

GEM Connection Layout

1 - The outlined section in the "1" circle of Figure 1 shows where the **current transformer** leads connect. Refer to "Current Transformers (CT)" section for more information.

2 – The two terminal blocks is where connection from a pulse signal connects. See "Pulse Count Inputs" chapter for more information

3 – Is the 3.5mm jack for connection to the **Potential Transformer (PT)**. The PT senses the line voltage and should be plugged into a receptacle as near as possible to the electrical panel for best accuracy

4 – This is not a USB connection! This mini USB jack may be used as an alternate power supply or PT signal jack.

5 - The **5VDC power supply** plugs into an outlet. The power supply cable then plugs into the barrel jack.

6 – This auxiliary terminal block provides +3.3VDC or +5VDC supply for auxiliary devices.

7 – The "1-Wire" bus connection for temperature sensors.

8 – The RS-232 communication terminal block

13 – Status LEDs. The "System" LED (left) provides GEM operational status while the "Communication" LED (right) shows the status of the communication module.

Safety

All safety rules described below must be obeyed. Please read carefully before proceeding with the installation of the GreenEye Monitor and associated current transformer. Brultech Research Inc. assumes no liability for failure to comply with the safety guidelines described below.

The GREENEYE MONITOR (GEM) operates as a "Class II" low voltage device. This requires that all external connected signals be low voltage (<50V) and provided by Class II approved power supply and sensors.

All of our power supplies are UL, CSA or UL/c approved for use in USA and Canada. Most of our current transformers (CT) are UL/c listed. No direct line connections to the GEM are allowed. All signals must be galvanic isolated from the power-line.

WARNING !

Read All Of The Safety Rules Before Installing!

Never install the GEM inside an electrical panel. A separate "low voltage" panel may be used if required.

The GREENEYE MONITOR (GEM) installation requires the installation of current transformers (CT) installed inside the electrical service panel. This portion of the installation MUST be performed by a qualified electrician or individual. The installer must follow all local safety codes and use proper safety practices and equipment.

The qualified installer must be aware that main panels may still contain dangerous voltage levels even though the main breaker is in the "OFF" position.

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The following rules MUST be obeyed!

- **Any work performed inside the electrical panel must be done by an electrician or qualified individual. This individual will be familiar with the local electrical code and perform the installation accordingly.**
- **NEVER install the GreenEye Monitor (GEM) inside the electrical panel. Only low voltage (12VAC or less) galvanic isolated connections are to be made to the GREENEYE MONITOR (GEM) terminals.**
- **The current transformer (CT) leads must exit the electrical panel through an appropriate box connector, strain relief or bushing. The CT leads must be properly anchored on the outside of the panel.**
- **The portion of the CT leads inside the panel must not have any damage, cuts or wear to the outside insulation.**
- **The CT leads must be routed in such a way that its insulation will not be rubbing against live terminals. Care must be exercised not to pinch the CT leads especially when re-installing the panel cover.**
- **Do not install the CTs in panels with voltages greater than 300V.**
- **Do not install the GREENEYE MONITOR (GEM) in a wet location.**

Current Transformers (CT)

CT Types

Important: The GEM will accommodate two general types of CTs:

Type A : Millivolt output proportional to the sensed current

Type B : Milliamp output proportional to the sensed current

It is important to determine the type of CT used so that it may be properly connected to the GEM. Figure 2 describes the difference between the two types and also lists various CT models for each type.

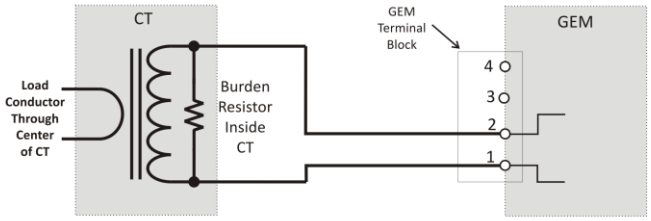
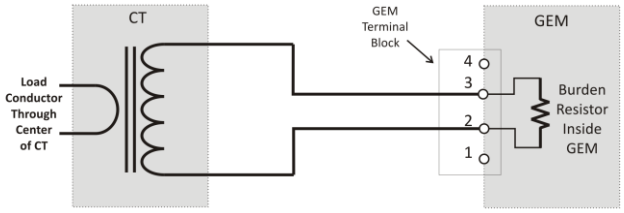
Type A CT	Type B CT
SPLIT-60, SPLIT-100, SPLIT-200, SPLIT-400/600	**Micro-40, SPLIT-30, Micro-50, Micro-80, Micro-100**
	
Type A CT has an internal burden resistor.	Type B CT has no internal burden resistor and uses the GEM's built-in burden resistor connected between terminals 2 and 3.

Figure 2

CT Orientation

The orientation specifies the direction that the CT is facing when installed on the circuit breaker conductor. The CT orientation is either facing toward or way from the breakers (Fig 3 left). Current transformers generally have a marking "K → L". This mark is used to specify the orientation of the CT. If there is no arrow on the CT, then identify something unique on the CT. (Fig 3 right). If using two or more CTs on a single channel, the orientation with respect to each other can be determined using this identifier. This will be explained later in this chapter.

If the CTs are installed with the improper orientation by mistake, this can be corrected by reversing the black/white leads when connecting to the GEM, rather than re-installing the CT. Paying attention to orientation will simplify the process of connecting the leads to the GEM.

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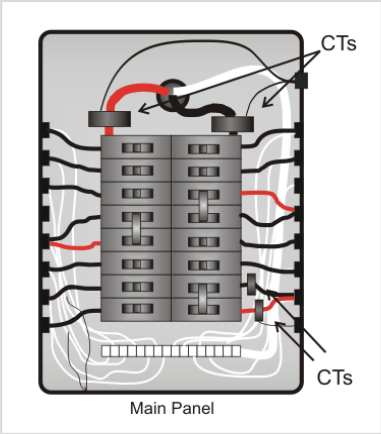
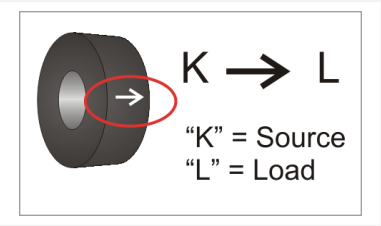




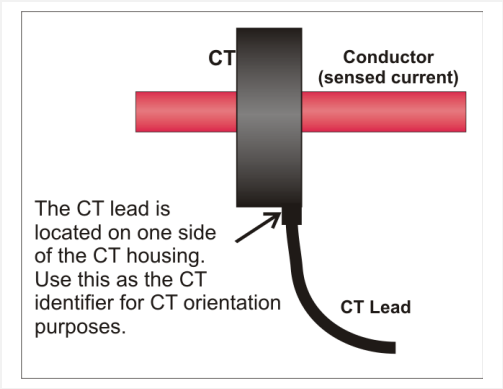


Figure 3

CT Connection

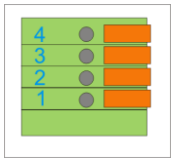
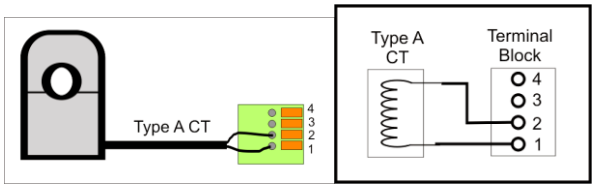


Figure 4

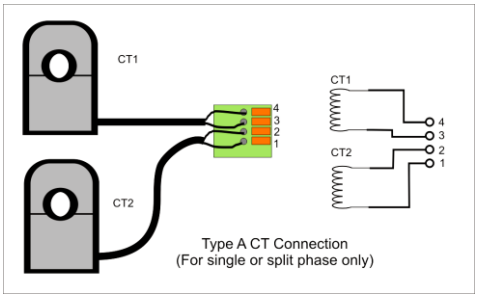
Each of the GEM's 32 channels has a four point terminal block (see Figure 4). Each point is numbered 1-4. The numbers are not marked on the terminal block. You must presume the number "1" to "4" starting from the bottom as displayed in Figure 4. The type of CT used determines which of the four terminals the CT leads will be connected to.

For single CT connection, the CT lead color does not matter as long as this is not a 3-phase installation. For example, if a CT connects to terminals #2 & #3, the black lead can connect to terminal #2 or #3 and the white lead to the other terminal.

***Type A* CT Connection**



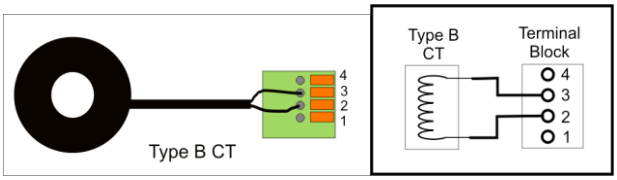
Single CT



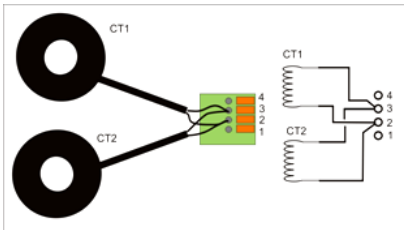
Dual CT

Figure 5

***Type B* CT Connection**



Single CT



Dual CT

Figure 6

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Connecting Two CTs on a Single Channel

North American residential electric services are 120V/240V split-phase systems. If a 240V load is to be monitored, you should determine if the load contains a neutral connection. If it does, then both L1 and L2 lines will require a CT since the current through L1 may not necessarily be the same as L2.

When connecting the leads of two CTs to a single channel, the sum of both CT currents will "add" or "subtract" depending on proper phasing. The desired result is the sum of L1 + L2 (addition of both currents). The basic rule to accomplish this is different based on the "Type" of CT used. The two paragraphs below will explain each.

Type A CTs

When using two "Type A" CTs to monitor a 240V load, one CT must be connected to #1 & #2 terminals and the other to #3 & #4 terminals. The rule for proper phasing is:

> **If both CTs are installed facing opposite directions and on different legs (Line1 and Line2) or if both CTs are installed facing the same direction and installed on the same leg (both on Line1 or both on Line2), then similar CT lead colors will connect to terminals 1 & 3 and the other two similar colors to terminals 2 & 4.**
>
> **If both CTs are installed facing the same direction and on different legs (Line1 and Line2) or if both CTs are installed facing opposite directions and installed on the same leg (both on Line1 or both on Line2), then CT similar colors will connect to terminals 2&3 and the other two similar colors to terminals 1 & 4.**

Type B CTs

When using two "Type B" CTs to monitor a 240V load, both CTs must be connected in parallel to terminals #2 & #3. The rule for proper phasing is:

> **If both CTs are installed facing opposite directions and on different legs (Line1 and Line2) or both CTs are installed facing the same direction and installed on the same leg (both Line1 or both Line2), then the same lead color of each CT will connect together**
>
> **If both CTs are installed facing the same direction and on different legs (Line1 and Line2) or both CTs are installed facing opposite directions and installed on the same leg (both Line1 or both Line2), then CT-1 lead will connect to non-similar lead color of CT-2**

Since there is a 50/50 chance of getting it right, you may choose not to pay attention to CT direction and lead phasing and simply try either combination to determine if the CT signals add or subtract. The higher of the two reading is the proper one.

Connecting More Than Two CTs

It is advised not to connect more than two CTs to a single channel, however in some cases the installer may want to group several rarely used circuits together. Modern homes will typically have 3 or 4 double-pole circuit breakers for the kitchen counters only which means 6 to 8 panel circuits. These usually power appliances such as a toaster, coffee machine, can opener, blender, etc. Since these appliances are seldom used, it may be desirable to group these together on two or three channels to conserve GEM channels.

More than two "Type A" CTs

Connect the "Type A" CTs in series (must all be the same CT model). You can use small wire nuts to daisy chain them together. Remember to pay attention to the CT lead polarity. The two ends of the CT chain then connects to CT terminals "1" and "4". See Figure 7 (left).

More than two "Type B" CTs

Connect the "Type B" CTs in parallel (must all be the same CT model). Use light gauge lamp cord or similar to create a short extension lead (see Figure 7 right side diagram). This enables connecting multiple CT leads together using a "wire nut"

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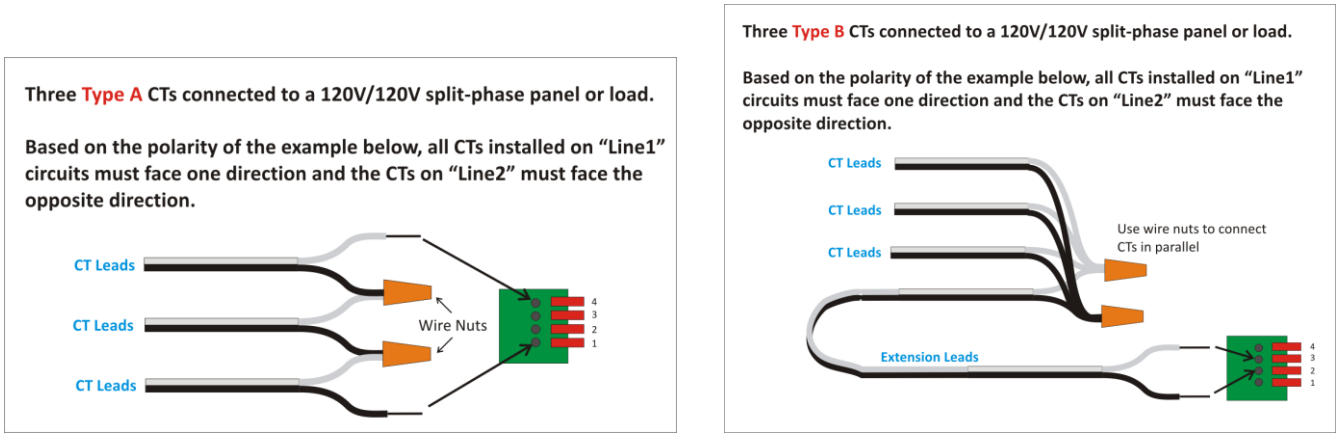

Figure 7

For more information please refer to the latest manual: "www.brultech.com/software"

CT Terminal Block

The GEM uses "spring loaded" terminal blocks. The wire to be inserted into the terminal block must be between 18AWG to 26AWG and stripped to a minimum of 10mm. If two wires must share a single terminal then the maximum gauge is 24AWG.

Figure 8 shows the procedure for connecting the CT leads to the terminal block.

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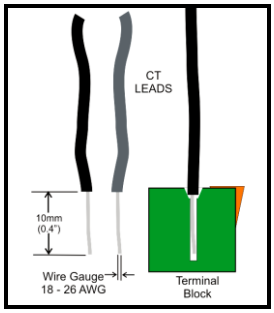
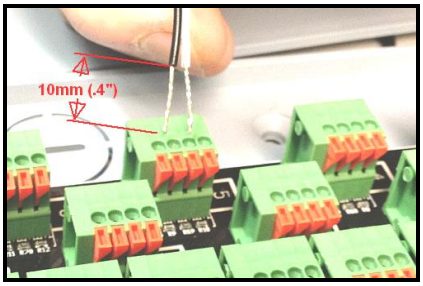
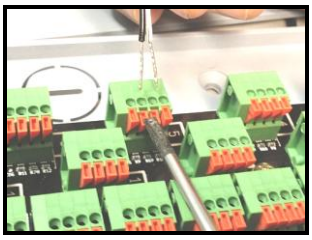
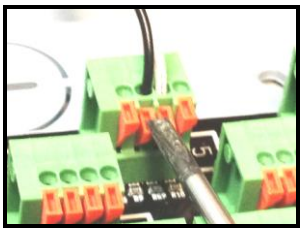
<tr><td> 
</td><td> 
</td></tr>
<tr><td>Make sure the wire is of the proper gauge and stripped to 10mm</td><td>Align the wire ends with the appropriate holes</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Press the spring lever with a flat screwdriver</td><td>Insert the wire ends fully and release the lever</td></tr>
</table>

Figure 8

Potential Transformer

The potential transformer (PT) is used to sample the power line voltage. Its function is to reduce the line voltage to safe levels and create "Class II" isolation between the power line and the GEM. The PT included in the GEM package is an AC wall transformer which must be connected to a 120VAC outlet as close as possible to the electrical panel monitored. The PT's 12VAC connects to the GEM via a 3.5mm phone plug. When plugging the PT's 3.5mm plug into the PT jack on the GEM, make sure the plug is fully inserted!

Other PTs are available for other voltage potential such as 240VAC.

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Pre-Plan the Installation

GEM Mounting Location

WARNING !

NEVER Install the GREENEYE MONITOR (GEM) unit inside the Electrical Panel

Determine the best mounting location for the GEM taking into consideration the length of the CT leads. Some CT models have longer leads than others. The two large main panel CTs such as SPLIT-100 or SPLIT-200 have longer leads than Micro-CTs do, so it may be preferable to locate the GEM at the opposite end of the panel feed from where the large CTs are installed. See Figure 9

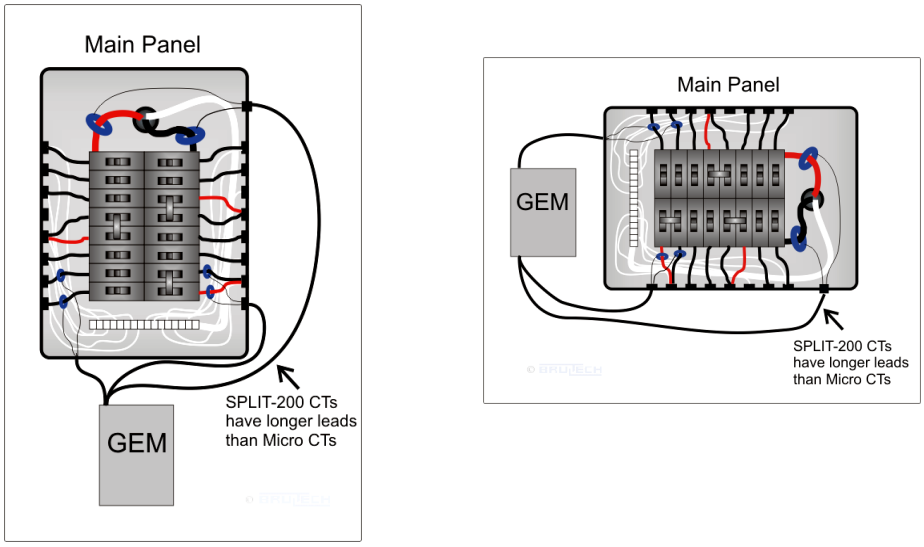

Figure 9

It is also important to consider where the CT leads will be routed when choosing a location to mount the GEM. If mounted too far away, the CT leads may not reach the terminal strips.

1-Wire Bus

The “1-Wire” bus is used to connect up to eight temperature sensors. All sensors connect to the same three wires (bus), see Figure 10. The sensors may be DS18B20 or DS18S20 types.

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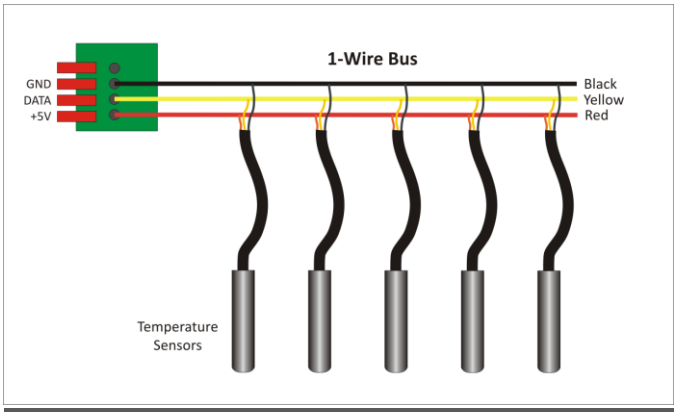

Figure 10

Pulse Count Inputs

The GEM has four pulse count inputs (see Figure 11). Pulse counter #1 and #2 are totally isolated from the GEM ground and circuit. If using any of these inputs, a DC pulse signal between 3V and 24VDC is required.

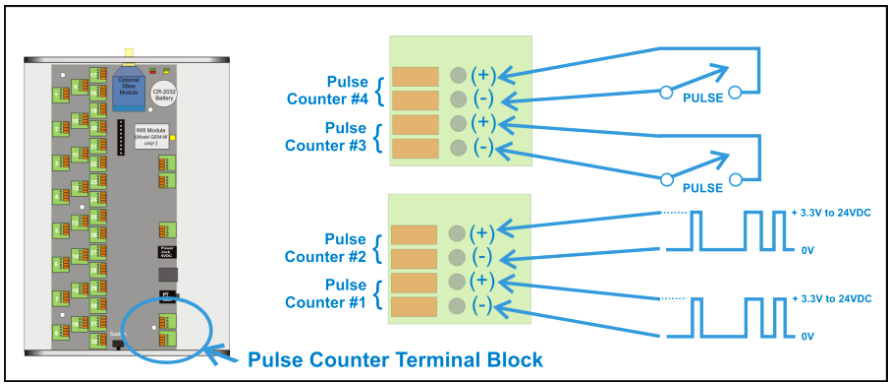

Figure 11

Pulse counters #3 and #4 are "dry" contact type counters. These inputs require switch contacts not connected to any power source, such as relay contacts or magnet switch contacts. Very low voltage from the circuit (5VDC) is used to complete the circuit.

RS-232 Port

Every GEM device comes with two RS-232 ports. The RS-232 port may be used to connect directly to an automation system, a "Serial to Ethernet" device such as "EtherPort" or to a serial to USB adaptor. Either of these ports may be used at the main communication gateway or simply to configure the GEM, the GEM's (optional) WiFi module or the GEM's (optional) XBee® module.

The GEM is capable of being put in "Bridge Mode" which causes Com1 and Com2 to be linked together so that the RS-232 port can talk directly to a module on the opposite port.

Connection to the RS-232 port is accomplished via terminal blocks #8 in the "layout" section.

Typically only one RS-232 port would be used therefore there is only one common (GND) connection available. See Figure 12.

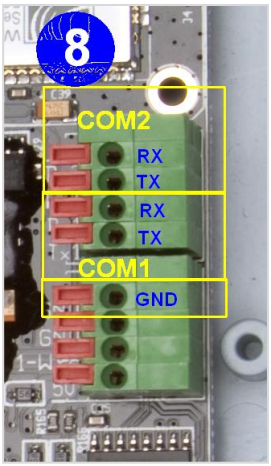

Figure 12

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Channel Assignment Worksheet

GEM CH #	Load Description	Breaker Number	Breaker Amps	CT Model	120V	240V 1-CT	240V 2-CTs
1			A				
2			A				
3			A				
4			A				
5			A				
6			A				
7			A				
8			A				
9			A				
10			A				
11			A				
12			A				
13			A				
14			A				
15			A				
16			A				
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31			A				
32			A				

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